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WILD ANIMALS AS A SOURCE OF FOOD

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
Special Scientific Report--Wildlife No. 98

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On the cover--A herd of Brindled Gnu or Blue Wildebeest, Connochaetes taurinus. (From a kodachrome slide by Samuel Jorgensen.)

Back cover--Cape Buffalo, Syncerus caffer. (Drawing by Bob Hines.)

UNITED STATES DEPARTMENT OF THE INTERIOR, STEWART L. UDALL, SECRETARY
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WILD ANIMALS AS A SOURCE OF FOOD

By

Lee M. Talbot

Smithsonian Institution

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F O R E W O R D

This paper by Dr. Lee M. Talbot is a stimulating treatise on a long neglected subject. Ordinarily when we speak of values associated with the harvest of wild ungulates we consider them from the standpoint of the sport and recreation produced and relegate to secondary consideration the food value of the animals.

Dr. Talbot's paper "Wild Animals as a Source of Food" is based largely on his own several years of research on ungulates in East and Central Africa. It dramatically illustrates the great potential for scientific game cropping in this vast area of Africa and other areas of the world.

Land managers frequently overlook the fact that the indigenous wild animals, having evolved with the environment, may be far more efficient in utilizing plants and converting them to protein than our few domestic animals.

Conditions over much of the land area of the earth because of climate, terrain, diseases, and other factors are unfavorable for the production of domestic livestock, yet in some areas as many as twenty species of wild ungulates thrive. These animals are greatly superior to domestic livestock in terms of biomass, carrying capacity, productivity, live weight gains, use of plant life and resistance to drought, diseases and parasites. Further, there is much evidence that some wild ungulates can be domesticated. The potential for scientific management with resulting great improvement in the economy and general well-being of the people involved is self evident.

It is to be hoped that the principles espoused by Dr. Talbot can gain greater acceptance throughout the world. The task will be very difficult, but the results will be supremely worth the effort.

John S. Gottschalk
Director, Bureau of Sport Fisheries
and Wildlife

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N O T E

Lee M. Talbot was formerly Director of the South East Asia Project of the International Union for Conservation of Nature and Natural Resources, and Consultant in Ecology and Conservation to the United Nations Special Fund, UNESCO, the Pacific Science Board of the National Academy of Sciences, and various African and Asian Governments. This paper was given, in August 1963, as an Invited Paper in the "Symposium on Animal Production under Adverse Climatic Conditions" at the Sixth International Congress of Nutrition held at Edinburgh, Scotland, as a contribution of the Museum of Vertebrate Zoology and Department of Geography, University of California at Berkeley. Dr. Talbot later collaborated with Lloyd W. Swift, Executive Secretary of the World Wildlife Fund, on a similar paper presented at the International Grasslands Congress held in Brazil in December 1964. Dr. Talbot is currently in the Office of Ecology, Museum of Natural History, Smithsonian Institution.

WILD ANIMALS AS A SOURCE OF FOOD

Lee M. Talbot

(Office of Ecology, Museum of Natural History,
Smithsonian Institution, Washington, D.C., U.S.A.)

Previous papers in this Symposium have discussed the problems involved in animal production under adverse climatic conditions using conventional domestic livestock. This paper discusses the possibility of accomplishing this purpose by using unconventional livestock - the indigenous wild animals.

Climatic conditions adverse to optimum domestic livestock production exist over large parts of the world. They range from arctic conditions to tropical, and from desert to rain forest. Within this spectrum of environments the range of conditions optimum for most domestic livestock is relatively narrow. Attempts to improve livestock production under adverse conditions have been confined to finding the domestic species most closely suited to the conditions involved and attempting to improve conditions to meet the animals' requirements. This improvement may involve provision of water, supplementary food, and fencing; bush control; stringent grazing control; disease control; and reseeding or other forms of vegetation management. Such practices are normally expensive. Often they are not feasible economically since under truly adverse conditions, even with intensive management, the yield of domestic livestock is relatively low. In such cases rather than attempt to adapt the range to conventional livestock it may be better to look for livestock better adapted to the existing conditions. Over much of the world such livestock exists in the form of the indigenous wild animals.

Although the principles discussed below apply to many parts of the world, the discussion is primarily concerned with the semi-arid tropics of East and Central Africa. Many of the data are drawn from wildlife research in the area conducted by the author from 1956 through 1962. The major part of this research was carried out jointly with his wife, under the sponsorship of the Foreign Field Research Program of the United States National Academy of Sciences-National Research Council, the New York Zoological Society, the Government of Kenya, and Rockefeller Foundation. Included in this research were cooperative studies

undertaken with Dr. W.J.A. Payne, director of the Animal Husbandry Division of the East African Agriculture and Forestry Research Organization at Muguga, Kenya. Additional pertinent data were obtained in June and July 1963 while carrying out a mission for the United Nations Special Fund involving integration of wildlife in the development and use of savanna lands of East and Central Africa.

Because of climatic and other factors, over the larger part of East and Central Africa animals provide the only reliable food crop. Rainfall is often low, irregular, and unreliable. Temperatures are seasonally high. Some three-quarters of the total land area is described by the broad term "savanna." It carries a cover of woody vegetation ranging in density from continous woodland through grassland types to semidesert bush. The balance between grasses and woody vegetation is generally unstable. The main factors modifying the vegetation are fire and the grazing, browsing, and trampling of animals; the balance is sufficiently delicate to present a major problem of range management with domestic livestock. Deterioration and consequent lowered production due to overgrazing accompanies virtually all open range grazing of livestock in the area, whether managed by Africans or Europeans. Much of the area is marginal or submarginal from the standpoint of maintaining domestic livestock, and, equally important, of maintaining the productivitiy of the land when grazed by this livestock. The Director of Agriculture in Kenya has stated that it is doubtful whether man would ever be able to manage marginal ranch land efficiently with the present narrow range of domestic livestock species (Brown, 1961).

Tropical breeds of livestock are somewhat better adapted to these habitat conditions than are temperate zone animals (Payne, 1964; Williamson and Payne 1959). However, even the so-called local breeds have been introduced into the area in relatively recent times. The truly indigenous livestock are the wild animals which have evolved with or in the environment.

COMPARISON OF WILD UNGULATES AND DOMESTIC LIVESTOCK

It is only logical that animals which evolved in an area should be better adapted to it than animals more recently introduced. In Africa this idea has been advanced by ecologists and wildlife biologists for some years. Only recently, however, has solid evidence from research been provided for comparisons. From these data it is now clear that on many range lands wild animals do make more efficent use of the

existing resources than domestic livestock, and high production can be maintained without adversely affecting the carrying capacity of the habitat. Therefore on such lands the wild animals offer a greater potential for sustained production of meat and other animal products than domestic livestock.

Evidence for this conclusion comes from comparisons between domestic livestock and wildlife as to standing crop, carrying capacity, meat production, reproductive rates, growth rates, diets, and water requirements.

Standing Crop and Carrying Capacity

On managed grasslands in East Africa the standing crop of domestic livestock averages roughly one animal weighing 1,000 pounds per 20 to 30 acres or 21,000 to 32,000 pounds per square mile. In East African acacia-savanna land owned by the Masai tribe the stocking rates of domestic livestock range from 11,200 to 16,000 pounds per square mile. In bush country denied access to cattle because of tsetse fly the standing crop of goats and sheep ranges from about 2,000 to 8,000 pounds per square mile. In contrast, identical acacia-savanna land supports a standing crop of 70,000 to 100,000 pounds per square mile of wild ungulates, and bush country grazed by wild ungulates exclusively carries some 30,000 pounds per square mile (Table 1).

To determine carrying capacity of an area one must start with the condition of the land rather than the numbers of animals. An area may carry a very high biomass but this means nothing unless it is correlated with the condition and trend (i.e., improvement or impairment of condition) of the land. The carrying capacity of land varies from year to year depending on climatic and other factors. Therefore any figures on carrying capacities must be considered approximations. However, from the standpoint of habitat condition and trend, the high standing crops of wildlife noted above appear within the carrying capacity of the land. The standing crops of domestic livestock, although substantially lower than those of wildlife, appear in virtually every case to exceed the carrying capacity of the land.

Productivity

There are several ways in which productivity of wildlife and domestic livestock may be measured. Reproduction, growth rates and

liveweight gains, and the meat yield per carcass are key factors and these are considered below.

Reproduction

Many native owned cattle in East and Central Africa do not breed until they are about 5 years old. The average breeding age of cattle is about 3.5 years, and with greatly improved management this may be brought down to about 2.5 years. Sheep and goats may breed first when just under a year old (Williamson and Payne, 1959). The gazelles (Gazella spp.), impalas (Aepyceros melampus), and many other wild ungulates which reach an adult weight of less than about 200 pounds will breed when under 1 year old. Animals whose adult weights run from around 250 to well over 1,000 pounds, including topi (Damaliscus lunatus), kongoni (Alcelaphus buselaphus), wildebeest (Gorgon taurinus), and eland (Taurotragus oryx) will breed when just over 1 year old, the females producing their first calf when about 2 years old.

The rate of reproduction of most wild animals is extremely high. The females of most wild ungulates up to the size of eland and buffalo (Syncerus caffer) normally produce at least one young a year.

Growth rate and liveweight gains

The average liveweight gain per day of cattle on moderately managed East African rangeland is 0.3 pounds (Talbot, Ledger and Payne 1962) and that of sheep in Tanganyika 0.12 pounds (Williamson and Payne, 1959). The liveweight gains of some of the principal species of wild ungulates (Table 2) range from 0.13 pounds a day for about 10 months for the Thomson's gazelle (Gazella thomsonii) to 0.73 pounds a day for 72 months for the eland.

Table 2 points out that wild ungulates reach marketable or economically harvestable size at an earlier age than domestic livestock. Cattle under native management in East and Central Africa reach marketable size in 5 to 7 years. Under more efficient management this stage might be reached in about 4 years. Sheep and goats require 1.5 to 2.5 years. Thomson's gazelles require roughly 15 months, Grant's gazelles (Gazella granti) and impalas about 18 months, topis and kongonis about 2 years, wildebeests 2.5 to 3 years, and elands about 3 years.

Table 1. Yearlong standing crops of domestic livestock and wild ungulates.

Type of Range	Location	Animals	Yearlong standing crop in pounds/square mile
Acacia-savanna	Kenya Masailand	Cattle, goats, sheep[1/]	11,000 - 16,000
Acacia-savanna	Kenya Masailand	Mixed wild ungulates[1/]	70,000 - 100,000
Moderately managed grasslands	Kenya highlands	Cattle[2/]	21,000 - 32,000
Acacia-commiphora bushland	Kenya-Tanganyika Masailand	Sheep, goats[1/]	2,000 - 8,000
Acacia-commiphora bushland	Kenya-Tanganyika Masailand	Mixed wild ungulates[1/]	30,000

1/ This study.
2/ Henderson (1950).

Table 2. Comparative growth rates of domestic livestock and wild ungulates on East and Central African range.

Species	Approximate live-weight gain per day in pounds	Approx. Period Months	Average adult weight in pounds	
			females	males
Thomson's gazelle[1/]	0.13	10	41	53
	0.08	15		
Impala[1/]	0.26	10	101	131
	0.20	18		
Grant's gazelle[1/]	0.26	10	101	146
	0.22	18		
Topi[1/]	0.44	12	252	292
	0.34	24		
Kongoni[1/]	0.50	12	270	332
	0.39	24		
Wildebeest[1/]	0.52	12	360	460
	0.44	24		
	0.41	30		
Eland[2/]	0.73	72	1,000	1,600
Domestic sheep[3/]	0.12	18	44	100
Domestic cattle[1/]	0.30	38	350	1,000

1/ Talbot et al., 1962
2/ Posselt, 1963
3/ Williamson and Payne, 1959

Meat yield

A good index of the meat yield of an animal is its killing-out percentage, that is, the butcher's carcass weight expressed as a percentage of live weight. The killing-out percentage of the majority of African owned cattle seldom exceeds 50.0; long-legged tropical meat goats average about 45.0; and "indigenous" sheep about 44.0 (Williamson and Payne, 1959). In comparison, the killing-out percentage of wildebeests averages about 50.6, kongonis 52.5, topis 53.6, Thomson's gazelles 56.8, elands 58.6, impalas 59.5, and Grant's gazelles 63.2 (Talbot, et al., 1962).

As detailed by Ledger (1963a and 1963b) the carcasses of wild animals contain far less fat than those of domestic livestock. At a killing-out percentage of 51.0, game animals have a fat content of 1.8 percent while cattle contain 14.1 percent. For a killing-out percentage of 60.0, game contain 0.3 percent fat while cattle contain 28.4 percent. The production of lean meat is a more efficient use of fodder than is the production of fat (ibid.). Consequently in terms of meat production the wild animals with virtually no fat make far more efficient use of the available vegetation than do the domestic animals. And the wild animals produce significantly more lean meat (protein) per pound of liveweight than do the domestic animals.

Another index of relative worth of carcasses is the carcass balance, i.e., the proportion of hindquarter to forequarter when the carcass is divided between the tenth and eleventh rib (ibid.). A preponderance of hindquarter is advantageous. In this respect most wild ungulates are superior to domestic livestock raised on the same lands (ibid.).

Nutrition

Diet

There is a wide variety of ungulate species found in East and Central Africa, and it is not unusual to find over 20 species of ungulates inhabiting the same area. The available food is in the form of herbs, grasses, and woody plants which range from low bushes to tall trees. In the open grasslands there are over 100 species of common grasses and associated herbaceous plants. Results of the present

studies have shown that each species of ungulate appears to have a yearlong preferred diet different from and complementary to the others. Some species of animals eat different classes of food. Giraffes (Giraffa camelopardalis) for example, feed largely on trees; rhinoceros (Diceros bicornis) feed largely on brush; while wildebeests eat grass almost exclusively.

But within the different classes of food the diets are also complementary either as to species of food plants eaten or to the stage of growth of a given plant. Red oats grass (Themeda triandra) for example, although not eaten by some ungulates, is the most important single item in the diets of wildebeests, topis, and zebras in western Kenya and Tanganyika. The wildebeests choose the fresh leaves of this grass until they reach about 4 inches in length. Stalks and seed heads are rarely taken and only 4 percent of the red oats identified in wildebeests' stomachs was dry. Zebras feed on red oats grass primarily when it is more mature. Most of the leaves eaten by them were over 4 inches long and stalks and heads were frequently taken. Zebras also avoided the grass when it was dry. Topis, on the other hand, showed a marked preference for dry red oats grass, and over 50 percent of the red oats in the stomachs of the topis examined were dry. Most of the rest were mature, about 20 percent stalks and heads.

The individual diets of the wild herbivores differ from one another in various respects including crude protein, dry matter, and moisture content. They appear to provide the optimum nutrition for the animals involved. When the animals are denied their preferred diets they may still survive, but various lines of evidence -- including age of females at first breeding, timing and success of breeding, pre- and post-natal survival and differential sexual mortality of the young, resistence of population to drought stress, and biomass -- indicate that alternate diets provide a lower plane of nutrition (Talbot and Talbot, 1963a, 1963b).

These nonduplicating food preferences result in the efficient use of virtually all the available vegetation to support the biomass of mixed wild herbivores; whereas when cattle, goats and sheep graze, only one class of food, grass, and only a few species within that class, are the preferred forage and most efficient source of nutrition (Heady, 1960).

Water requirements

Normally cattle in East and Central Africa are watered daily, although during drought periods they may be watered only once every 3 days. They rarely are grazed more than 3 to 5 miles from water. Although water in forage satisfies some of the body water requirements, all domestic livestock require additional water at more or less regular intervals. Consequently large areas of potential grazing land are denied domestic livestock during the dry seasons due to lack of sufficient water.

The water requirements of the wild animals vary greatly. Some animals such as the wildebeests and zebras (Equus burchelli) normally drink each day or two. Others such as the Grant's gazelle and oryx (Oryx gazella) live for months in areas where no surface water is available. Most of the wild ungulates will drink frequently where water is available, but they are able to go waterless for some days and travel long distances to find water if necessary with no apparent adverse effect on maintenance of life or growth rate. A large and vigorous wild ungulate population, therefore, can be supported yearlong on a range where short water supply renders only a limited population of domestic livestock possible.

THE HARVEST

From the foregoing discussion it is clear that from a biological standpoint it would be possible to obtain a higher sustained yield of meat products from wild ungulates than from domestic livestock on the marginal lands involved. There are three questions that arise then: (1) Are the meat and other animal products satisfactory and desirable for human use? (2) Is it possible and economical to harvest wild animals? (3) Why have not wild animals been exploited as a meat resource previously? These questions are considered below.

Animal Products

Meat

Although there are local preferences and taboos, the meat of all species of wild ungulates is eaten readily by various tribes of Africans in East and Central Africa. Game meat has provided a staple source of protein for many Europeans and Africans in the area. Shade dried "biltong" is currently selling in cities in Central and South Africa at the

same or higher prices than comparable beef. Fresh game meat, when available, sells readily at prices comparable to beef. During 1962. for example, in the cities of Bulawayo and Salisbury, Southern Rhodesia, 130,000 pounds of fresh game meat and 36,000 pounds of dried meat were sold (Department of Wild Life Conservation and Federal Veterinary Services, 1963). Game meat, including hippopotamus (Hippopotamus amphibius) has been canned on a small-scale experimental basis and has found ready acceptance by Europeans and Americans.

During the recent United Nations mission to East and Central Africa the author and other members ate meat from over a dozen species of wild ungulates. In most cases it was difficult to differentiate between the game meat and high quality meat from domestic livestock. Wild animals properly killed, butchered, and handled do not have the strong "gamey" taste often associated with game meat shot and prepared by sportsmen. The strong gamey flavour comes from meat partly spoiled or tainted through poor shooting, improper cleaning and bleeding, allowing the meat to contact hair and visceral contents, and insufficient cooling and hanging. Given the same ill-treatment, prime beef will also have a gamey taste which would require strong spices to cover.

Properly prepared, the meat of virtually all wild ungulates is as satisfactory and desirable for human consumption as that of domestic livestock.

Byproducts

In addition to the high quality meat there are various other animal products provided by game harvesting. The hides of zebras and some other animals have a ready, high priced market overseas. Prime zebra hides, for example, are sold by the game harvesters in East and Central Africa at a wholesale price of 7 or 8 pounds sterling ($19.60 - $22.40). Ivory from elephants (Loxodonta africana) is particularly valuable and has long been a substantial source of income for the various governments involved. The horns of some animals are readily sold for specialty markets, and various other trophies, including hippo teeth, elephant, giraffe and wildebeest tails, and some hoofs, all produce significant byproduct income.

Harvest Methods

Free-ranging animals and game ranching

Free-ranging wild animals are somewhat more difficult to harvest than domestic livestock that can be driven to the slaughter house. However, it can be done on a large scale with surprising efficiency and economy. The most widespread method is by shooting, often with a spotlight at night. The animals are shot, bled, and taken back to a central abbatoir, for butchering.

Members of the United Nations mission accompanied a regular night harvesting operation at one game ranch in Southern Rhodesia. In roughly 1½ hours 17 animals had been collected by 1 car. At another ranch that was visited the operation was so efficient that even elephants weighing several tons were loaded onto trucks using collapsable derricks and transported immediately back to the abbatoir.

On one ranch in the same area, game harvesting has continued for about 10 years at a constantly increasing rate. The wild animals are still plentiful, the yield is greater than that of cattle on the same land, the animals have not been dispersed by the operation, and since they are not shot by a car in the daytime, they are as tame and easy to approach from a car in daylight as those in many national parks and reserves.

Game harvesting on an organized basis is a relatively new industry and is increasing rapidly. In the Transvaal between 2,000 and 3,000 private farms and ranches are harvesting wildlife on a commercial basis (Riney, 1963). In that area in 1959 alone over 7 million pounds of meat were taken from private ranches, and this does not include meat from government owned and managed wildlife ranches and reserves (ibid.). In Southern Rhodesia, although one ranch has harvested wild animals for about 10 years, game ranching on an organized basis has been in operation for only about 3 years (Savory, 1963; Dasmann, 1963; Mossman, 1963). Nine large cattle ranches are now harvesting wildlife and they have founded a Game Ranchers Association. Examples of large scale game harvesting from other countries include harvest of the Saigan antelope (Saiga sp.) in the U.S.S.R. where by 1961 over 200,000 were killed annually in a commercial operation (Harthoorn, 1961).

Economic game cropping is not limited to ranch-type operations. In Northern Rhodesia, for example, there are two small scale but economic pilot cropping operations on African reserves. In Uganda a profitable

hippo harvesting program has been in operation for over 5 years, and in Kenya there are economic elephant and zebra cropping schemes.

Cattle ranching in East and Central Africa is very heavily subsidized by the governments. Veterinary services, marketing and cold storage commissions, and a variety of other services provide very substantial support for the cattle rancher. At the present time game ranching receives no such subsidies. On the contrary, it must operate in spite of severe market restrictions due to veterinary regulations and the opposition of many cattle ranchers. In spite of these difficulties and the problems that accompany development of a new industry, game ranching has proved profitable enough to attract many cattle ranchers who state they are making a greater profit from the game, or game and cattle, than from cattle alone on the same lands.

Game ranching at present requires very little capital expenditure. The wildlife is there for the harvesting so there is no capital outlay for stock. Fences, water supplies, and other types of range improvements are not essential. However, as game ranching achieves a wider acceptance and becomes more established it will probably prove desirable to improve production even further through some forms of range management. Wildlife as well as domestic livestock responds to management.

Domestication

Another possibility for the utilization of wild ungulates is through domestication. It is curious that Africa, with the world's greatest variety of hoofed wild animals, has not produced any domesticated livestock. In Neolithic times various wild African ungulates were tamed or domesticated, but apparently none have been since (Zeuner, 1963). This situation appears to be due more to human and environmental factors than to the potential for domestication of the animals themselves. The Belgians, for example, in the former Belgian Congo have shown that the African elephant can be domesticated in the same manner as the Asian one. The human population of Africa, until recent years, has been low in relation to the available food resources. Wherever it was required, hunters usually had a ready source of wild meat. The Africans who are pastoralists generally hold their animals as specific objects of prestige and almost of reverence, rather than purely as sources of animal products. Consequently, perhaps, the modern Africans have not felt the need or the inclination to experiment with domestication of other types of animals.

There has been much speculation on the possibilities of domesticating wild ungulates for ranching purposes. Individual animals of virtually all species have been tamed and raised as pets, but very little research has gone into raising wild animals as domestic herds. The potential of this, however, has been shown by a tame eland herd in Southern Rhodesia. Since 1954 an Agricultural Officer in that country has maintained a herd of elands, keeping records on such factors as reproduction and growth rates (Posselt, 1963). This herd breeds and thrives in captivity. It is periodically put over a weighbridge, and herded and handled in the same manner as cattle, except that the animals are more placid and easier to manage than most range cattle. They have been milked and some have been castrated. They can be confined by normal wire fences, and when grazing free they do not join wild elands in the vicinity. From the evidence to date, they appear to be an extraordinarily satisfactory "domestic" animal combining productivity and adaptation to the environment in a degree superior to that of normal livestock, and providing manageability not found in free-ranging wild ungulates (ibid.).

Problems Involved

Attitudes toward harvest of wildlife

The idea of commercial utilization of wildlife is affected by a complex series of human attitudes. The nature of the problem is well illustrated in East and Central Africa. Most of the indigenous peoples regarded wildlife as a source of animal products and hunted it as such. In several African languages the word for wild animal also means meat. The European administrators and land owners have variously regarded wildlife as a source of sport hunting, an object to be rigidly protected in restricted areas for aesthetic reasons, or as an obstacle to "proper" land development. The consequent prevailing idea of conflict between the interests of people and the interests of animals strongly affects the attitudes about land use of administrations and technical services. It also mitigates against wildlife being considered seriously as a resource of the land. The recent change in this attitude and slowly growing appreciation of the potential value of wildlife as a resource for animal products stems largely from the work of visiting wildlife management experts. These scientists, largely from America, have pointed out the need to manage wildlife to keep it within the carrying capacity of its range. Also they have stressed the potential value of wildlife as a resource of animal products in addition to its existing value as the basis of the important tourist industry.

There is still a body of opinion opposed to harvest of wildlife on sentimental or other grounds, but it is gradually being overcome by the obvious needs and the success of the present relatively small scale operations.

Disease and marketing

An important obstacle to more rapid expansion of wildlife harvesting in East and Central Africa is the series of veterinary restrictions based on the dangers of disease. Although disease may be controlled in domestic livestock, the same measures often cannot be applied to free-ranging wild animals. The presence or absence of livestock diseases is often a determining factor in the export industry of these countries. Because of the danger of disease transmission, meat from both wild and domestic animals often cannot be transported from the areas where it grows to the areas where there is a demand for it.

There are many strong opinions but there is still relatively little solid scientific information on the incidence of diseases in wild animals and their transmission to and from domestic livestock. Further research is required on this subject to facilitate proper exploitation of the wildlife resource in this area. It is possible that canning might provide the best means of overcoming the disease dangers in processing and marketing meat from both game and livestock in quarantine areas. Investigation in this field is also required.

Techniques

Development and improvement of techniques is a problem basic to almost any new industry. Although effective methods are now being employed, further development work is required to adapt techniques of management, harvest, and processing of wild animals to the different conditions involved.

SUMMARY AND CONCLUSIONS

Conditions adverse to optimum production of domestic livestock exist over much of the world. Many areas are marginal or submarginal for maintenance of domestic livestock, and equally important, for maintenance of

the productivity of the land when grazed by this domestic livestock. These conditions, however, are optimum for the production of the indigenous wild animals which evolved in or with them.

In East and Central Africa, for example, equivalent savanna lands will support and maintain a substantially higher standing crop of mixed wild ungulates than of domestic livestock. In terms of liveweight, pound for pound the crop of wild ungulates is significantly more productive than that of domestic livestock from the standpoints of age and rate of reproduction, liveweight gain and spped of maturity, killing out percentage and carcass balance, and protein yield. Through their differential, nonduplicating diets and more flexible water requirements a mixed population of wild ungulates makes far more efficient use of the available forage and water than do domestic animals.

Properly prepared, the meat of most wild ungulates is of high quality and is as satisfactory and desirable for human consumption as meat of domestic livestock. Wild animals also produce valuable by-products such as highly priced skins and ivory, and they are the basis of a valuable tourist industry.

Game harvesting is a relatively new industry, but is has been demonstrated to be a practical and successful use of the land. Economic game harvesting operations are being carried out in many countries. Most present harvesting is of free-ranging animals but experiments with an eland herd have shown the potentialities of domestication of some wild species.

On many lands wild animals clearly offer greater potential for sustained production of meat and other animal products than do domestic livestock. With the world's expanding need for animal products it is desirable and logical to further develop the possibilities of increasing animal production through utilization of the wild ungulates. 1/

1/ For a comprehensive review of the literature on the subject of this paper, with special reference to Africa, see Talbot, et al., 1965.

REFERENCES

Brown, L. 1961. Range Management. (Conference paper abstract). In Conference on land management problems in areas containing game, Lake Manyara, Tanganyika, by H. C. Pereira. p. 45

Dasmann, R. F. 1963. Game ranching in African land-use planning. International Union for the Conservation of Nature and Natural Resources, Publication 1 (New Series), p. 133-136. Morges, Switzerland.

Department of Wild Life Conservation and Federal Veterinary Services. 1963. Report to the United Nations Wildlife Mission, Salisbury, Southern Rhodesia. (Mimeo)

Harthoorn, A. M. 1961. Some aspects of game cropping. (Conference paper abstract). In Conference on land management problems in areas containing game, Lake Manyara, Tanganyika, by H. C. Pereira. p. 44

Heady, H. F. 1960. Range management in East Africa. 125 p. Government Printer, Nairobi (Kenya).

Henderson, G. R. 1950. Rumeruti grazing trails. Annual Review of the Kenya Department of Agriculture. 82 p.

Ledger, H. P. 1963a. The importance of stock selection for increasing the productivity of semiarid areas. International Union for the Conservation of Nature and Natural Resources, Publication 1 (New Series), p. 223-231. Morges, Switzerland.

Ledger, H. P. 1963b. A note on the relative body composition of wild and domesticated ruminants. Bulletin of Epizootic Diseases of Africa, Vol. 2, p. 163-165.

Mossman, A. S. 1963. Wildlife ranching in Southern Rhodesia. International Union for the Conservation of Nature and Natural Resources, Publication 1 (New Series), p. 247-249. Morges, Switzerland.

Payne, W.J.A. 1964. Specific problems of semiarid environments. Proceedings of the Sixth International Congress of Nutrition, Edinburgh, 1963. p. 213-227

Pereira, H. C. 1961. Conference on land management problems in areas containing game, Lake Manyara, Tanganyika, 20-22 February. Summary, Part I. East African Agricultural and Forestry Journal, Vol. 27, No. 1, p. 40-46.

Posselt, J. 1963. The domestication of the eland. Rhodesian Journal of Agricultural Research, Vol. 1, p. 81-87.

Riney, T. 1963. Utilization of wildlife in the Transvaal. International Union for the Conservation of Nature and Natural Resources, Publication 1 (New Series), p. 303-305.

Savory, C. R. 1963. Game utilization in Southern Rhodesia. (Mimeo)

Talbot, L. M., H. P. Ledger, and W.J.A. Payne. 1962. The possibility of using wild animals for animal production in the semiarid tropics of East Africa. Festschrift zum VIII Internationaler Tierzuchtkongress, Hamburg, p. 205-210. Stuttgart.

Talbot, L. M. and Martha H. Talbot. 1963a. The wildebeest in Western Masailand, East Africa. Wildlife Monographs, No. 12. The Wildlife Society, Washington, D. C. 88 p.

Talbot, L. M. and Martha H. Talbot. 1963b. The high biomass of wild ungulates on East African savanna. Transactions of the North American Wildlife Conference, Vol. 28, p. 465-476.

Talbot, L. M., W.J.A. Payne, H. P. Ledger, Lorna D. Verdcourt, and Martha H. Talbot. 1965. The meat production potential of wild animals in Africa; a review of biological knowledge. Commonworth Agricultural Bureau (England), C.A.B. Technical Communication, No. 16, 42 p.

Williamson, G. and W.J.A. Payne. 1959. An introduction to animal husbandry in the tropics. Longmans, Green and Co., London. 435 p.

Zeuner, F. E. 1963. A history of domesticated animals. Hutchison and Co., London. 560 p.

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